NATIONAL RADIO ASTRONOMY OBSERVATORY

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10 January 2011

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Promoting More Efficient Use of Spectrum Through Dynamic Spectrum Use Technologies	)	ET Docket No. 10-237

Comments of the
National Radio Astronomy Observatory
Charlottesville, VA 22903

1. The National Radio Astronomy Observatory ("NRAO" or "the Observatory") is pleased to provide comments responding to the Commission's Notice of Inquiry, FCC 10-198 ("the NOI") "Promoting More Efficient Use of Spectrum Through Dynamic Spectrum Use Technologies."

2. NRAO (http://www.nrao.edu), operated by Associated Universities, Inc., (http://www.aui.edu) under a cooperative agreement with the National Science Foundation, is the largest observatory dedicated to radio astronomy and one of the largest observatories of any kind in the world. NRAO operates one dozen radio astronomy stations in rural and remote regions of the United States (see Table 1), all of which observe in bands whose protection should be considered when rules are formulated to enable new technologies affording dynamic spectrum access.

3. Protection of passive service spectrum use presents unique considerations for dynamic spectrum access given:

    a. The impossibility of detecting passive use by spectrum sensing;
    b. The existence of localized quiet and coordination zones applicable to otherwise-unprotected spectrum;
    c. The use of exceptionally low signal levels.

4. Two of these points (3a and 3c) were addressed in the NOI. At ¶21, the Commission inquires whether spectrum-sensing requirements need to be determined band-by-band based on the incumbent services. ¶28 of the NOI notes the possible need to limit out

of band emissions more stringently when bands are accessed that are adjacent to those used by services requiring detection of very weak signals, one of the hallmarks of the radio astronomy service.

5. Three issues are of paramount importance to protection of radio astronomy in regard to active radio systems employing dynamic spectrum access. To protect radio astronomy and other passive use, such radio systems should incorporate:

    a. Rules (policies) regarding transmissions in or adjacent to protected bands;
    b. Rules (policies) regarding muting in coordination and quiet zones;
    c. Geo-location abilities.

6. Incorporation of rules regarding protection of spectrum bands used by incumbent services will hardly be particular to the protection of radio astronomy but the universal incorporation of rules preventing transmissions in exclusive passive bands (US246) is an extreme example.

7. Moreover, some spectrum bands enjoy footnote protections such as US342 that reads in part, "In making assignments to stations of other services to which the bands *[band list omitted]* are allocated … all practicable steps shall be taken to protect the radio astronomy service from harmful interference." Policies disallowing transmissions in US342 bands and limiting out of band emissions in adjacent spectrum could be straightforwardly incorporated into systems employing dynamic spectrum access.

8. Radio astronomy operations are protected in localized quiet and coordination zones, even outside spectrum bands that are allocated to or otherwise protected for use by radio astronomy. As examples:

    a. Within the National Radio Quiet Zone (operating under Part 1.924 of the Commission's rules) fixed transmitters are coordinated with the NRAO to ensure that emissions reaching the NRQZ reference point are below levels that are defined across the entire radio spectrum;

    b. The Commission's rules already forbid operation of TV band devices inside radio astronomy observatories, e.g. within 2.4 km of most stations and inside an approximately 20 mile square area about the center of the eVLA operated by NRAO (Table 1 below); see FCC 10-174, ET Docket 04-186.

9. Absent other means of notifying a device of the need to protect radio astronomy operations *in situ*, and given that spectrum sensing (hardly a reliable facility anyway) of passive use is not possible, an inherent geo-location capability is currently the only way to ensure such protection. Devices lacking the means to ascertain their location will have no way of knowing that they should not access seemingly unused spectrum.

10. At ¶46 of the NOI the Commission discusses unlicensed spectrum use above 38.6 GHz; the Commission is also currently considering this spectrum in the context of creating new experimental radio licenses (ET Docket 10-236, see FCC 10-196). The

Commission notes the use of such spectrum for ISM and some active services, including the Fixed Service at 57 – 64 GHz, concluding that "most bands above 38.6 GHz are very lightly utilized or lie fallow." Absent any recognition in the NOI, NRAO notes that radio astronomy also has substantial allocations above 38.6 GHz and there are several exclusive passive bands at mm-wavelengths. NRAO has previously remarked that low-lying harmonics of short-range FS transmissions at 57 – 64 GHz propagate much more freely than the fundamental and coincidentally fall in passive service bands around 115 and 230 GHz.

11. NRAO suggests that unlicensed devices employing dynamic use of spectrum above 38.6 GHz may protect incumbent radio astronomy use to the extent that they incorporate the policies and geo-location capabilities that are required at lower frequencies.

12. At ¶43 of the NOI the Commission notes that spectrum bands may occasionally become vacant, however temporarily. The Commission discusses how to make such spectrum available for innovative uses during the transition to new incumbents. That spectrum could be especially valuable to radio astronomy operating on a non-interference, non-protection basis in the interim, in the absence of any new rules, if radio astronomy operators were made aware of such opportunity.

13. In summary: to protect radio astronomy operations, radio systems employing dynamic spectrum access should incorporate policies recognizing protected spectrum bands and tailor transmissions accordingly, to keep in-band and out of band emissions at or below permitted levels. They should incorporate geo-location capabilities so that policy may be correctly applied, observing localized restrictions on the spectrum in quiet and coordination zones. Dynamic spectrum access should not be predicated solely on spectrum sensing. These are general principles that apply across the radio spectrum.

Respectfully submitted,

National Radio Astronomy Observatory
By:

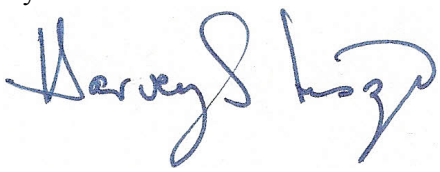

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Table 1

NRAO Instruments

NRAO Telescope	West Longitude	North Latitude	Height
Robert C. Byrd Green Bank Telescope (GBT)	79° 50' 24"	38° 25' 59"	825 m
Expanded Very Large Array (eVLA)	107° 37' 04"	34° 04' 44"	2126m
Very Long Baseline Array (VLBA):			
Brewster, WA	119°40' 55"	48° 07' 53"	255 m
Fort Davis, TX	103° 56' 39"	30° 38' 06"	1615m
Hancock, NH	71° 59' 12"	42° 56' 01"	309 m
Kitt Peak, AZ	111° 36' 42"	31° 57' 22"	1916m
Los Alamos, NM	106° 14' 42"	35° 46' 30"	1967m
Mauna Kea, HI	155° 27' 29"	19° 48'16"	3720m
North Liberty, IA	91° 34' 26"	41° 46' 17"	241 m
Owens Valley, CA	118° 16' 34"	37° 13' 54"	1207m
Pie Town, NM	108° 07' 07"	34° 18' 04"	2371m
St. Croix, VI	64° 35' 03"	17°45’31"	16m